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Kyoto University

# Freshwater Algae from the Nepal Himalaya, collected by a member of the Japanese Climbing Expedition

by

Minoru HIRANO

The third climbing expedition to Mt. Manaslu of the Himalayan Mountain Range, led by Mr. Aritsune MAKI, took place during the first half year of 1956, and Mr. Toshio IMANISHI, a member of the expedition, who made a small collection of algae in the course of his climbing expedition has given me his material to examine. The writer published a paper on the algae of the Napal Himalaya a short time ago; the present contribution is a second report on Napalese algae. The material studied in the present work were collected in almost the same course to Mt. Manaslu as that followed by Dr. Sasuke NAKAO. The stations where the later collections were made are quite different from those of the previous report, and the species of algae found are also quite different. The following table shows a comparison of groups of algae between the previous and the present report:

| Year of Collection / Name of groups | 1953 | 1956 |
|---|---|---|
| Blue-green algae | 22 | 11 |
| Green algae (excluding desmids) | 24 | 13 |
| Desmids | 79 | 22 |
| Golden algae (Chrysophyceae) | 3 | 1 |
| Diatoms | 69 | 41 |
| Euglenoid algae | 0 | 10 |
| Total | 197 | 96 |

As a whole, the total number of species is not so great as that of the previous collection; however the collections are characteristic in plankton-species, especially in green algae. The desmids are ralatively small in num-

ber in every place and this is due to the fact that the collection was not made from a boggy-water or swamp location; the diatoms, too, are not so great in number owing to the planktic collections. However, this does not show a scantiness of desmids or diatoms in the Himalayan district. The algal flora of the present report is quite similar to the flora of Japan and Europe. The places of the present collections are shown, together with a short note, as follows:

1. The pond beside the Museum of Kathomandu. Water temperature was 21°C in the afternoon of March 6, 1956.

2. Dilli Bazaar. A pond near the side of Mr. KRISHNA's house. Water temperature was 16.7°C at 10 a.m., March 6, 1956.

3. A pond at to the right of the entrance to Patan village. Air temperature was 14°C, water temperature 18°C, at 5 p.m., March 5, 1956.

4. A pond near Patan. Water temperature was 30°C., June 9, 1956.

5. A pond at Rani Pokhari. Water temperature 23°C., March 10, 1956.

6. A pool on the way to Bodnut temple. Water temperature was 21°C.

7. A pool situated to the right side of the Buri Gandaki River at an elevation of about 770 metres above the sea, is about three hours distance from Arughat Bazaar. The pool faces the Great Rock Cliff which is characterized by black spots on the face of white rock. This pool is used as a bathing place by buffaloes.

8. A permanent pool lying at the right side of the lower end of the Manaslu glacier ice fall. The area of the pool is about four square metres, and its altitude is about 4000 metres above the sea. Water temperature at 11 a.m., April 5, 1956, was 14°C.

9. A pool lying on the ridge continuing to the Naike peak from the back mountain of the base camp. Its altitude is about 4140 metres above the sea. Water temperature at 11 a.m., April 10, 1956, was 7°C.

10. A glacier lake below Rarkya Pass: altitude about 4850 metres above the sea, and water temperature 2°C.

Among the collections obtained from ten places, numbers 1–7 were collected in lower districts, less than 1000 metres above sea level; numbers 8–10 were collected in high alpine regions of about 4000 metres or more. The

high places correspond to the upper limit of tree-growing. The writer did not observe any phytoplankton in the present material from the two glacier lakes the same as found in the glacier lake of Sama in the previous collection made by Dr. Sasuke NAKAO; however, four algae (blue-green algae two and desmids two) were observed in the material of the glacier lake lying below Rarkya Pass. They are:

*Aphanothece castagnei* *Cosmarium undulatum* var. *minutum*
*Phormidium papyraceum* *C. abbreviatum* forma *pygmaea*

Also two species of blue-green algae *Phormidium autumnale* and *Lyngbya stagnina* were observed in the pool lying at the lower end of the Manaslu glacier ice fall. According to Mr. Toshio IMANISHI's note, some mosses were growing in 2°C waters of the glacier lake below Rarkya Pass; the elevation of that lake is about 4850 metres above the sea, so that the above mentioned four species must have been growing among mosses or attached to moss-polsters, and would be collected by plankton net in collections. There is, supposedly, a considerable amount of algae in moist soils or in pools near the side of the glacier, even on the alpine zone of Himalaya.

The alga-flora of the lowland area of Nepal is fairly rich in species number, and comprises various kinds of algae in every pond or pool; the flora consists almost entirely of Eurasian elements; however, some are rare, and are sporadically distributed far away from each other. Some are shown as follows:

*Colasium cyclopicola*, *Chlorogonium maximum*

The desmids in collected places were quite similar to those of Europe and Japan.

## Enumeration of species

### Cyanophyta

### Chroococcaceae

**Microcystis flos-aquae** (WITTR.) KIRCHN. in GEITLER Krypt. Fl. **14**, p. 138, f. 59e, f, 1932.

Colony spherical; cells densely disposed, 4.3$\mu$ in diameter.

Hab. Rani Pokhari, appeared in abundant as plankton. Distr. Previously

known to exist in Burma. Cosmopolitan species.

**Aphanothece castagnei** (BRÉB.) RABENH. in GEITLER Süssw. fl. **12**, p. 74, f. 63, 1925; SKUJA Symb. Sinica **1**, p. 14, pl. 1, f. 1, 1937.

Cells elliptic, 2.6$\mu$ in breadth and 4.4$\mu$ in length.

Hab. in glacier lake below Rarkya Pass. Distr. Previously known to exist in Yunnan, South China. Cosmopolitan species.

## Nostocaceae

**Nostoc paludosum** KÜTZ. in GEITLER Krypt. Fl. **14**, p. 836, f. 528a, 1932; HUBER-PESTALOZZI Binnengew. **16**: 1, p. 196, f. 92, 1938.

Colony spherical; trichome enveloped in gelatinous substance and entangled, 2.6$\mu$ in breadth.

Hab. No. 3. Distr. Cosmopolitan.

**Anabaena globosa** HIRANO, sp. nov.

Trichomata solitaria inter alias algas planctonicas libere natantia regulariter flexuosa vel irregulariter spiralia, subcircularia vel semicircularia, 9.5–10.8$\mu$ in diametro sine vagina gelatinosa; spirae circa 60$\mu$ lata sunt, cellulis vegetativis sphaericis vel seriaformibus cum distincte pseudovacuolis leviter constrictis ad geniculatum; heterocystis sphaericis leviter magnoribus quam cellulis vegetativis, circiter 10.8–13$\mu$ in diametro; sporis sphaericis vel late ellipticis singulatim vel saepe 2–7 in seriatim contiguis ordinatis, circiter 13–14.6$\mu$ in diametro et 14–17.2$\mu$ in longitudinem, ad heterocystis contiguis.

Trichome solitary, free floating, regularly coiled or irregularly contorted, 9.5–10.8$\mu$ in diameter without gelatinous sheath, vegetative cells spherical or elliptic (barrel shaped) slightly constricted at the cross wall, with distinct pseudovacuoles; heterocystis spherical slightly larger than the vegetative cell, about 10.8–13$\mu$ in diameter, resting spore spherical or broadly elliptic about 13–14.6$\mu$ in diameter and 14–17.2$\mu$ in length, adjacent to the heterocyst and often developed in catenate series. (Pl. I, fig. 11–13)

Hab. Rani Pokhari in Kathomandu.

This planktic species was found with *Microcystis flos-aquae* in a mixed state. The trichome of this species is regularly coiled generally 3–4 times; the breadth of the coils about 60$\mu$. This species resembles *A. spiroides* in

flexuose nature of trichome and globose heterocyst, but the resting spores are globose and connect 2 or 3 spores in a uniseriate chain; furthermore seven spores are often connected with one another. The breadth of vegetative cell and heterocyst is somewhat larger than the cell of *A. spiroides*. This species also resembles *A. planctonica* and *A. circinalis*, but differs from the former by the coiled trichome and the position of the resting spore against the heterocyst and differs from the latter by the form and size of the spore and its separated position to heterocyst.

Oscillatoriaceae

**Oscillatoria princeps** VAUCH. in GEITLER Krypt. Fl. **14**, p. 947, f. 598a, 601c-g, 1932; HUBER-PESTALOZZI Binnengew. **16**: 1, p. 234, f. 175, 1938.

Trichomes 56-60$\mu$ in breadth and 6.5$\mu$ in length, slightly constricted at the cross wall, and slightly attenuated near the apices which, possess calyptra (43$\mu$ in breadth).

Hab. No. 4. Distr. Previously known to exist in Burma. Cosmopolitan.

**Phormidium ambiguum** GOM. in GEITLER Krypt. Fl. **14**, p. 1015, f. 647e, 1932.

Cells 5.2$\mu$ in breadth, about half times as long as broad, faintly constricted at the cross wall, not attenuated towards the apices

Hab. No. 6. Distr. Previously known to exist in Burma. Cosmopolitan.

**Phormidium corium** (AG.) GOM. in GEITLER Krypt. Fl. **14**, p. 1018, f. 649 b, c, 1932; FRÉMY Mém. Soc. Nat. Sci. **41**, p. 89, pl. 23, f. 6, 1934.

Trichomes 3.4$\mu$ in breadth, slightly longer than broad, not granulated and constricted at the cross wall.

Hab. No. 4. Distr. Cosmopolitan.

**Phormidium fragile** GOM. in GEITLER Krypt. Fl. **14**, p. 999, f. 636c, d, 1932.

Trichomes 3$\mu$ in breadth, distinctly constricted at the cross wall; apical cell long conical.

Hab. No. 5. Distr. Previously known to exist in South-west China, Europe, N. America, and Africa.

**Phormidium papyraceum** (AG.) **Gom.** in GEITLER Krypt. Fl. **14**, p. 1020,

f. 650a, b, 1932; FRÉMY Mém. Soc. Nat. Sci. **41**, p. 90, pl. 23, f. 7, 1934.

Trichomes not constricted at the cross wall, 4.3$\mu$ in breadth and only half as long as they are broad.

Hab. No. 10. Distr. Previously known to exist in Burma. Cosmopolitan species.

**Phormidium autumnale** (AG.) GOM. in GEITLER Krypt. Fl. **14**, p. 1026, f. 652k, l, 653a, 1932.

Trichomes 4.3$\mu$ in breadth, about as long as broad or slightly shorter than broad, not constricted at the cross wall.

Hab. No. 5. Distr. Cosmopolitan.

**Lyngbya stagnina** KÜTZ. in GEITLER Krypt. Fl. **14**, p. 1066, f. 679b, 1932.

Trichomes 13$\mu$ in breadth without sheath, about 1/3 times longer than broad.

Hab. No. 8. Distr. Previously known to exist in Pamir, Europe.

## Euglenophyta

### Euglenaceae

**Phacus acuminatus** STOKES in LEMMERMANN Süssw.-fl. **2**, p. 138, f. 233, 1913; HUBER-PESTALOZZI Binnengew. **16**: 4, p. 192, f. 224, 1955.

Cells 25–26$\mu$ in length and 23–24$\mu$ in breadth.

Hab. No. 7. Distr. Europe, N. America, S. Africa.

**Phacus Makii** HIRANO, sp. nov.

Cellulae mediocriter magnae, ellipticae vel elliptico-ovatae cum caudus rectus robustus acute attenuatus mediocriter longus ordinatae, marginibus lateralibus valide incisuris, incisuris singulis unilateralis vel utrobique in margine medianis, granulis paramylaceis magnis discoidis annulatis in centrum cellulae ordinatis et paene dimidius longius quam latis cellularum, long. sine caudus 64.5$\mu$, cum caudus 86–95$\mu$. (Pl. I, fig. 8, 9)

Cells fairly large, elliptic or elliptic-ovate with a strong robust and fairly long caudus which is straight and sharp toward the apex, paramylon bodies large, disc-shaped, disposed at the center of the cell, and at least half as long as it is broad, lateral margin has a deep incision in one or both sides; periplast numerous and small, disc-shaped. Cell length 64.5$\mu$ without caudus,

86–95$\mu$ with caudus, 43–45.2$\mu$ broad.

Hab. No. 7.

**Phacus crenatus** HIRANO, sp. nov.

Cellulae modicae, asymmetrice subellipticae, parte dorsalis arcuatae valide incisurae, incisuris duobus equidistantibus in margine lateris, parte ventralis paullo convexae mediocriter incisurae, incisuris in medio et subapice marginis lateris; caudus robustus longe et acute attenuatus et recurvatus; granulae paramylacea discoidea duobus in centrum cellulae ordinatae; chloroplastae viridia discoidea parva numerosa, long. cell. 86$\mu$ cum caudus et 64.5$\mu$ sine caudus, lat. cell. 31.8$\mu$; membrana striata. (Pl. I, fig. 10.)

Hab. No. 2.

Cells of medium size, asymmetrically subelliptic in outline, gullet somewhat laterally disposed and near the anterior end, posterior end produced into a long and robust caudus which is somewhat recurved and sharp at the end, lateral margin 2–3 crenated, dorsal side 3 and ventral side 2; cell wall longitudinally punctate-striated, series of striation convergent at both ends; paramylon body two and globular in form, length of cell 64.5$\mu$ without caudus, 86$\mu$ with caudus, breadth of cell 31.8$\mu$.

This species resembles *Ph. lismorensis* but differs from it by the lateral position of gullet in the ventral side, the asymmetry of the cell outline, and also by an unequal crenation in both lateral sides.

**Phacus suecicus** LEMM. var. **inermius** NYGAARD in Det. Kongl. Dansk. Vid. Selsk. Biol. Skr. **7**: 1, p. 172, f. 106c–e, g, i, j, 1949.

Cells wothout caudus 34.4$\mu$, with caudus 41.3$\mu$ in length; 24.5$\mu$ in breadth. (Pl. 1, fig. 7.)

Hab. No. 2. Distr. Denmark.

**Euglena acus** EHRENB. in LEMMERMANN Süssw.-fl. **2**, p. 129, f. 209, 1913; GOJDICS Eugl. p. 99, pl. 11, f. 1, 1953.

Cells elongate cylindrical with parallel lateral margin, posterior end prolonged into long caudus, paramylon bodies long cylindrical and two or three in number. Cells 180–187$\mu$ in length and 10.7–11$\mu$ in breadth.

Hab. No. 2. Distr. Cosmopolitan.

**Euglena proxima** DANG. in LEMMERMANN Süssw.-fl. **2**, p. 129, f. 193, 1913;

HUBER-PESTALOZZI Binnengew. **16**: 4, p. 86, f. 64, 1955; PRINGSHEIM Nov. Act. Leop. n. f. **18**, p. 60, f. 8, 1956.

Cells 64.5$\mu$ in length and 17.2$\mu$ in breadth.

Hab. No. 7. Distr. Europe.

**Trachelomonas armata** (EHRENB.) STEIN forma **inevoluta** DEFL. in PRESCOTT Alg. Great Lakes Area p. 411, pl. 83, f. 33, 1951; HUBER-PESTALOZZI Binnengew. **16**: 4, p. 308, f. 583, 1955.

Cells 30-31$\mu$ in length and 24-24.7$\mu$ in breadth. The lorica is brown in colour.

Hab. No. 2. Distr. Europe, North America.

**Trachelomonas oblonga** LEMM. in Süssw.-fl. **2**, p. 147, f. 278, 1913; HUBER-PESTALOZZI Binnengew. **16**: 4, p. 278, f. 459, 1955.

Cells 38-38.6$\mu$ in length and 34-34.6$\mu$ in breadth.

Hab. No. 2. Distr. Europe.

**Colacium cyclopicola** (GICKLH.) BOURR. in HUBER-PESTALOZZI Binnengew. **16**: 4, p. 126, f. 109, 1955.

Cells 21.5-22$\mu$ in length and 8.6-9$\mu$ in breadth. (Pl. I, fig. 2.)

Hab. No. 1. Distr. Europe.

Chrysophyta

Bacillariophyceae

Coscinodiscaceae

**Cyclotella Meneghiniana** THWAITES in Hustedt Krypt. Fl. **7**: 1, p. 338, f. 171a, 1930.

Diameter of valve 13.2$\mu$.

Hab. No. 2, 4. Distr. Cosmopolitan.

Fragilariaceae

**Meridion circulare** AG. in A. CLEVE Diat. Schw. Finn. **2**, p. 14, f. 312, 1953.

Valve 48.5$\mu$ in length and 6.2$\mu$ in breadth.

Hab. No. 7. Distr. Europe.

Eunotiaceae

**Eunotia angusta** (GRUN.) Å. BERG in A. CLEVE Diat. Schw. Finn. **2**, p.

81, f. 407g, 1953.

Valve 26.4$\mu$ in length and 5.7$\mu$ in breadth. (Pl. II, fig. 2.)

Hab. No. 4. Distr. Europe.

**Eunotia indica** GRUN. in SKUJA Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**, p. 167, pl. 36, f. 24, 25, 1949.

Valves 35$\mu$ in length, 7.5$\mu$ in breadth, striae 7-8 in 10$\mu$. (Pl. III, fig. 5.)

Hab. No. 3. Distr. India, Burma.

Achnanthaceae

**Achnanthes conspicua** MAYER in Krypt. Forsch. I. p. 212, pl. 6, f. 9, 10, 1919; A. CLEVE Diat. Schw. Finn. **3**, p. 38, f. 554, 1953.

Valves 13-13.5$\mu$ in length and 4.3-4.5$\mu$ in breadth. (Pl. III, fig. 6.)

Hab. No. 6. Distr. Afghanistan, Europe.

**Achnanthes delicatula** (KÜTZ.) GRUN. in Van HEURCK Synop. Diat. Belg. p. 130, pl. 27, f. 3, 4, 1885; HUSTEDT Krypt. Fl. **7**: 2, p. 389, f. 836, 1933.

Valves 13-13.5$\mu$ in length and 7$\mu$ in breadth. (Pl. II, fig. 12.)

Hab. No. 4. Distr. Europe.

**Achnanthes exigua** GRUN. in HUSTEDT Krypt. Fl. **7**: 2, p. 386, f. 832a, b, 1933; A. CLEVE Diat. Schw. Finn. **3**, p. 35, f. 544a-d, 1953.

Valves 17.5-18$\mu$ in length and 8-8.3$\mu$ in breadth. (Pl. II, fig. 1.)

Hab. No. 4. Distr. Afghanistan, Europe.

**Achnanthes Imanishii** HIRANO, sp. nov.

Valva inferiori elliptico-lanceolata vel longe rhomboida, apicibus obtuse rotundatis, 17-43$\mu$ longa, 6-8.5$\mu$ lata. Area axialis angusta et linea, non expansa prope centrum valvarum. Raphe directa sed interdum leniter curvata prope centrum. Striae lineolatae, fere parallelae, 8 in 10$\mu$, sed dissimilis interruptae prope centrum, in parte centrali ad unum striae in formam triangulari separate ordinatae et in parte alius centrali nullae. Valva superiori pseudoraphe angusta, lineari, centrali, striis transversalibus omnes manifesto punctatis. (Pl. II, fig. 3, 4, 10, 11.)

Inferior valves elliptic-lanceolate or often long rhomboid, apices obtusely rounded, 17-43$\mu$ long and 6-8.6$\mu$ broad, axial area narrowly linear and not expanded at the centre, raphe straight but faintly curved in one side near

the middle, striae linear, almost parallel, about 8 in 10$\mu$, interrupted at the middle in unequal manner, striae isolated in groups triangular in manner on one side and quite absent on other side. Superior valves with a straight and narrow-linear pseudoraphe, striae punctated, 7–8 in 10$\mu$.

Hab. A pond near Patan.

**Cocconeis placentula** EHRENB. var. **lineata** (EHRENB.) CLEVE in HUSTEDT Krypt. Fl. **7**: 2, p. 348, f. 802d, 1933.

Hab. No. 4. Distr. Cosmopolitan.

Naviculaceae

**Frustulia rhomboides** (EHRENB.) De TONI var. **saxonica** (RABENH.) De TONI in HUSTEDT Krypt. Fl. **7**: 2, p. 729, f. 1099a, 1937.

Hab. No. 7. Distr. Cosmopolitan.

**Stauroneis phoenicenteron** EHRENB. in HUSTEDT Süssw.-fl. **10**, p. 255, f. 404, 1930; A. CLEVE Diat. Schw. Finn. **3**, p. 210, f. 944e, 1953.

Valves 62–84$\mu$ in length and 15.3$\mu$–19.8$\mu$ in breadth.

Hab. No. 4, 6. Distr. India, Yunnan, Setschwan, Afghanistan, Europe.

**Stauroneis phoenicenteron** EHRENB. var. **intermedia** (DIPPL.) A. CLEVE in Diat. Schw. Finn. **3**, p, 210, f, 944e, 1953.

Valves 66–84$\mu$ in length and 15.4–20$\mu$ in breadth.

Hab. No. 2, 4, 6. Distr. Europe.

**Navicula cryptocephala** KÜTZ. in HUSTEDT Süssw.-fl. **10**, p. 295, f. 496, 1930; A. CLEVE Diat. Schw. Finn. **3**, p. 154, 1953.

Valves 27–28.5$\mu$ in length and 7.4–7.8$\mu$ in breadth. (Pl. III, fig. 15.)

Hab. No. 4. Distr. Yunnan, Setschwan, Pamir, Afghanistan, Europe.

The forms from the Patan-pond are similar to *Navicula Gregaria* but differ from it by the prominently radial arrangement of the striae.

**Navicula mutata** KRASSKE in A. CLEVE Diat. Schw. Finn. **3**, p. 163, f. 829a, b, 1953.

Valves 17–18$\mu$ in length and 6–6.5$\mu$ in breadth. (Pl. III, fig. 9.)

Hab. No. 4. Distr. Europe.

**Navicula Kriegeri** KRASSKE in A. CLEVE Diat. Schw. Finn. **3**, p. 170, f. 853A, 1953.

Valves oblong-elliptic with rounded end, striae densely disposed, slightly radial, axial area narrow-linear, without central area, 12.8–13.4$\mu$ in length and 6.4–6.7$\mu$ in breadth. (Pl. II, fig. 8.)

Hab. No. 7. Distr. North Europe.

**Navicula dicephala** (Ehrenb.) W. Smith in Hustedt Süssw.-fl. **10**, p. 302, f. 526, 1930; A. Cleve Diat. Schw. Finn. **3**, p. 142, f. 792a–d, 1953.

Valves 28–28.5$\mu$ in length and 10–10.5$\mu$ in breadth. (Pl. III, fig. 11.)

Hab. No. 6. Distr. India, Yunnan, Setschwan, Afghanistan, Europe.

**Navicula lanceolata** (Ag.) Kütz. in Hustedt Süssw.-fl. **10**, p. 305, f. 540, 1930; A. Cleve Diat. Schw. Finn. **3**, p. 134, f. 772a, b, 1953.

Valves rhomboide-lanceolate with rounded end, 44–47$\mu$ in length and 8–9$\mu$ in breadth, striae radial, punctate-striated, axial area sublinear and slightly expanded at the middle, central area small elliptic. The specimens from Patan do not always exactly agree with the European description and figure, margin almost straight (instead of convex). Skvortzow described a new form of *Navicula hasta* (f. *minor* Skv.) from Lake Hanka, Manchuria, but the present Nepalese specimens differ from it in the form of the central area. (Pl. III, fig. 8.)

Hab. No. 4. Distr. Afghanistan, Japan, Europe.

**Navicula cuspidata** Kütz. in Hustedt Süssw.-fl. **10**, p. 268, f. 433, 1930; Skvortzow Philip. Journ. Sci. **62**, p. 200, pl. 4, f. 9, 1937.

Valves 96.8–106$\mu$ in length and 17.6–19.8$\mu$ in breadth.

Hab. No. 6. Distr. Japan, Yunnan, India, Europe.

**Navicula peregrina** (Ehrenb.) Kütz. var. **hankensis** Skvortzow in Mém. S. Ussur. Br. Russ. Geogr. Soc. p. 48, pl. 4, f. 10, 1929.

Valves rhomboide-lanceolate, with broadly rounded end, 35–37$\mu$ in length and 8.5–8.8$\mu$ in breadth, striae radial, axial area narrow-linear slightly expanded at the middle, central area small elliptic. The variety resembles *Navicula mollis*, *N. Koenigi* and intermediate form of *Navicula cryptocephala*, figured by A. Cleve, but do not agrees with their dimensions. (Pl. III, fig. 10.)

Hab. No. 4. Distr. Yunnan, Manchuria.

**Pinnularia microstauron** (Ehrenb.) Cleve in Hustedt Süssw.-fl. **10**, p. 320, f. 582, 1930; A. Cleve Diat. Schw. Finn. **4**, p. 55, f. 1073a–c, 1955.

Valves linear-lanceolate with broadly rounded rostrated ends, margin parallel not inflated at the middle, 39.6–53$\mu$ in length and 10.5–11$\mu$ in breadth, raphe filamentous, straight, axial area narrow linear but expanded at the middle, central area rhomboidal, transverse striae interrupted at the middle and radial but convergent at the end. (Pl. II, fig. 16, 17.)

Hab. No. 4, 6. Distr. Yunnan, Tibet, Afghanistan, Manchuria, Europe.

**P. microstauron** var. **ambigua** MEISTER in Beitr. Krypt. Schw. p. 162, pl. 28, f. 2, 1912; HUSTEDT Süssw.-fl. **10**, p. 320, 1930; A. CLEVE Diat. Schw. Finn. **4**, p. 55, f. 1073e, f, 1955.

Valves somewhat inflated at the median part, with three slightly undulated margins, 50.6–70.4$\mu$ in length and 9.2–10.6$\mu$ in breadth, axial area somewhat broader than that of the typical form, in other respects as the typical form. (Pl. II, fig. 18.)

Hab. No. 4. Distr. Setschwan, Europe.

**Pinnularia biglobosa** (SCHUM.) A. CLEVE forma **interrupta** A. CLEVE in Diat. Schw. Finn. **4**, p. 28, f. 1029b, c, 1955.

Valve 44$\mu$ in length and 8$\mu$ in breadth. (Pl. II, fig. 6.)

Hab. No. 6, 7. Distr. Europe.

HUSTEDT described a new species of *Pinnularia* from Mus-tagh-ata of Pamir as *Pinnularia Hedini*, based on the material of collection by Sven HEDIN. This species is large in size and corresponds to twice the size of the present form and is also similar to this form by the shape of the cell and its valve structure.

**Pinnularia stauroptera** (RABENH.) CLEVE var. **lanceolata** A. CLEVE in Diat. Schw. Finn. **4**, p. 68, f. 1091u–w, 1955.

Valves lanceolate with slight convex and subparallel lateral margins, end broad and truncately rounded and somewhat rostrated, 53–57$\mu$ in length and 8.8–11$\mu$ in breadth, central area broad rhomboidal, series of transverse striae interrupted at the middle, radial near the middle but convergent at the end. This variety resembles *Pinnularia Brébissonii* var. *truncata* but differs from it by slightly larger cells and slightly rostrated ends of the valves. (Pl. II, fig. 13.)

Hab. No. 2, 4, 6. Distr. Europe.

**Pinnularia biceps** GREG. var. **minor** (B. PETERS.) A. CLEVE in Diat. Schw. Finn. **4**, p. 63, f. 1088k-n, 1955.

Valves with somewhat capitated ends, 26-27$\mu$ in length and 8-8.6$\mu$ in breadth, central area broad rhomboidal, striae interrupted, radial near the middle and convergent at the end. This variety resembles *Pinnularia Brébissonii* var. *hybrida* but bears a more capitated end. (Pl. II, fig. 7.)

Hab. No. 6. Distr. Europe.

**Pinnularia divergentissima** (GRUN.) CLEVE in Van HEURCK Synop. Diat. Belg. pl. 6, f. 32, 1885; HUSTEDT South. Tibet **6**, p. 128, pl. 9, f. 6, 1922.

Valves narrow linear-lanceolate, gradually attenuated towards the well rounded end, 30-32$\mu$ in length and 5-5.5$\mu$ in breadth, striae interrupted at the middle, radial but convergent at the end, axial area linear but gradually expanded towards the centre, central area long rhomboidal. (Pl. II, fig. 5.)

Hab. No. 6. Distr. Tibet, Pamir, Europe.

**Pinnularia dactylus** EHRENB. in A. CLEVE Diat. Schw. Finn. **4**, p. 72, f. 1100a, 1955; HUSTEDT Süssw.-fl. **10**, p. 332, f. 615, 1930.

Valves 190-196$\mu$ in length and 30-32$\mu$ in breadth.

Hab. No. 2. Distr. Europe.

**Pinnularia brevicostata** CLEVE in A. CLEVE Diat. Schw. Finn. **4**, p. 37, f. 1045a, b, 1955.

Valves linear-lanceolate with well rounded ends, 104-108$\mu$ in length and 23-24$\mu$ in breadth, axial area broad, linear-lanceolate without special central area, striae radial at the middle, convergent at the end, length of striae do not extend beyond half of the valve width. According to the explanation of A. CLEVE, *Pinnularia brevicostata* described and figured by HUSTEDT belong to *P. crucifera* var. *elongata*.

Hab. No. 2. Distr. Europe.

**Pinnularia major** (KÜTZ.) CLEVE in A. CLEVE Diat. Schw. Finn. **4**, p. 70, f. 1094a, 1955; HUSTEDT Süssw.-fl. **10**, p. 331, f. 614, 1930.

Valves 156-163$\mu$ in length and 26-27$\mu$ in breadth.

Hab. No. 2. Distr. Europe.

**Pinnularia sudetica** HILSE var. **leptogongyla** (EHRENB.) A. CLEVE in Diat. Schw. Finn. **4**, p. 76, f. 1105k, i, 1955.

Valves 80–82$\mu$ in length and 13–13.4$\mu$ in breadth.

Hab. No. 1. Distr. Europe.

**Pinnularia interrupta** W. Smith in Hustedt Süssw.-fl. **10**, p, 317, f. 573b, 1930.

Valves with distinctly capitated ends, 38–42$\mu$ in length and 8.5–9$\mu$ in breadth, transverse striae gradually shortened towards the middle part of the valve and broadly interrupted at the middle, disposed in radial but convergent at the end, axial area narrow-linear, gradually expanded towards the center, central area broadly rhomboidal. This species resembles *Pinnularia biceps* var. *amphicephala*, transfered from *P. amphicephala*, described by A. Mayer and Hustedt's *P. braunii* var. *amphicephala*, but is distinguished by smaller valves and shape of central area. W. Smith's original figure of *P. interrupta* shows an almost straight lateral margin (delicately inflated side) but the present specimens bear straight sides, and sometimes a faint retuse side. (Pl. II, fig. 14.)

Hab. No. 3. Distr. Europe.

**Pinnularia gibba** W. Smith in A. Cleve Diat. Schw. Finn. **4**, p. 69, f. 1092a, b, 1955. (as *genuina* Mayer)

Valves slightly smaller than the European dimensions, 46–48.5$\mu$ in length and 8.5–9$\mu$ in breadth, distinctly capitated at the end, breadth of capitated end almost equal to the breadth of the valves, axial area fairly broad and linear, transverse striae somewhat short, slightly radial at the middle and convergent at the end.

Hab. No. 3. Distr. Europe.

**Pinnularia acrosphaeria** (Bréb.) W. Sm. var. **minor** Cl. in A. Cleve Diat. Schw. Finn. **4**, p. 25, f. 1022d, 1955.

Valves 48–50$\mu$ in length, 8.5–9$\mu$ in breadth, striae 11–12 in 10$\mu$. (Pl. II, fig. 15.)

Hab. No. 3. Distr. Northern Europe.

Cymbellaceae

**Cymbella ventricosa** Kütz. in Hustedt Süssw.-fl. **10**, p. 359, f. 661, 1930.—var. *genuina* Mayer in A. Cleve Diat. Schw. Finn. **4**, p. 124, f. 1177a–c, 1955.

Valves lunate or semielliptic, ventral margin almost straight and fairly inflated at the middle, dorsal margin strongly convex or arcuate, ends well rounded, 28–40$\mu$ in length and 8.5–11$\mu$ in breadth, raphe straight, excentric near the ventral margin, polar notch disposed near the end of valve, axial area narrow-linear and without a central area. This species resembles *C. turgida*, but is distinguished by a smaller valve and delicate marking of the striae. This species is probably distributed widely in the Nepalese districts. I have previously reported this species in various districts; FOGED also reported this species in many districts of Afghanistan. (Pl. III, fig. 3.)

Hab. No. 4. Distr. Nepal, Yunnan, Setschwan, Pamir, Afghanistan, Central Asia, Europe.

**Cymbella gracilis** (RABENH.) CLEVE var. **Girodi** (HÉR.) A. CLEVE in Diat. Schw. Finn. **4**, p. 129, f. 1184f–i, 1955.

Valves 28.4–37.4$\mu$ in length and 8.8–9.5$\mu$ in breadth. This variety resembles *C. ventricosa* but the end of valves is more acute than those of that species. The terminal notch of the present species is disposed separated from the end of the valves. Striae of dorsal side are disposed somewhat radially, and bear a distinct isolated puncta at the tip of the middle stria. A. CLEVE removed *C. norvegica* var. *curta* to this species as a variety. The present specimens agree well with forma *curta* of this variety figured by A. CLEVE. (Pl. III, fig. 4.)

Hab. No. 6. Distr. Europe.

**Cymbella helvetica** KÜTZ. in HUSTEDT Süssw.-fl, **10**, p. 364, 1930.—var. *genuina* MAYER in A. CLEVE Diat. Schw. Finn. **4**, p. 167, f. 1258a–d, 1955.

Valves narrow, ventral side almost straight but faintly inflated at the middle, 65–68$\mu$ in length and 8.6–9$\mu$ in breadth, axial area narrow-linear, central area small, slightly expanded, raphe straight, excentric. The valves of the present specimens were somewhat narrower than those of the European description. Nepalese specimens do not agree with the figure of the same species given by HUSTEDT. (Pl. III, fig. 17.)

Hab. No. 7. Distr. India, Afghanistan, Europe.

**Gomphonema olivaceum** (LYNGB.) KÜTZ. in A. CLEVE Diat. Schw. Finn. **4**, p. 191, f. 1291f, g, 1955.

Valves 30–37.5$\mu$ in length and 8.7–9.2$\mu$ in breadth. (Pl. II, fig. 9.)

Hab. No. 1, 4, 6. Distr. Japan, Afghanistan, Europe.

**G. olivaceum** var. **subramosum** Grun. in A. Cleve Diat. Schw. Finn. **4**, p. 192, f. 1291n, 1955.

Valves heteropolar, narrow-rhomboidal, apical end slightly broader than that of basal end, broadly rounded, 26–28$\mu$ in length and 6–6.5$\mu$ in breadth, axial area sublinear slightly expanded in centre, striae radial. This variety resembles *Gomphonema intricatum* var. *pumillum* but differs from it by equidistant disposition of striae in the centre, and by deficiency of isolate puncta. (Pl. III, fig. 12.)

Hab. No. 6. Distr. Europe.

**Gomphonema lanceolatum** Ehrenb. in Hustedt Süssw.-fl. **10**, p. 376, f. 700, 1930; A. Cleve Diat. Schw. Finn. **4**, p. 184, f. 1280a–e, 1955.

Valves 56–59$\mu$ in length and 12–13$\mu$ in breadth. (Pl. III, fig. 1.)

Hab. No. 5, 6. Distr. Assam, Afghanistan, Europe.

**Gomphonema turris** (Ehrenb.) Grun. var. **nepalense** Hirano, var. nov.

Valva angusta 66$\mu$ in longa et 12.3$\mu$ in lata, marginibus superioribus leviter brevioribus quam marginibus inferioribus. (Pl. III, fig. 2.)

Hab. No. 6.

This variety differs from the typical form by bearing narrower valves. The superior lateral margin is slightly shorter than that of inferior ones (in typical form superior lateral margin is half the length of the inferior ones).

**Gomphonema subclavatum** Grun. in A. Cleve Diat. Schw. Finn. **4**, p. 183, f. 1277a, b, 1955.—*Gomphonema montanum* Schum var. *subclavatum* Mayer in Skvortzow Mem. South Ussur. Br. Russ. Geogr. Soc. p. 52, pl. 6, f. 16, 1929.

Valves 33–35$\mu$ in length and 11.7–12.3$\mu$ in breadth. (Pl. III, fig. 13.)

Hab. No. 4. Distr. Siberia, India, Tibet, Afghanistan, Europe.

## Epithemiaceae

**Epithemia proboscidea** (Kütz.) W. Smith in A. Cleve Diat. Schw. Finn. **5**, p. 41, f. 1413a, b, 1952.

Valves 51–54$\mu$ in length and 7.7–8$\mu$ in breadth.

Hab. No. 4. Distr. Europe.

Nitzschiaceae

**Hantzschia amphioxys** (EHRENB.) GRUN. in A. CLEVE Diat. Schw. Finn. **5**, p. 46, f. 1419a–c, 1952.

Valves 18–92$\mu$ in length and 15–15.7$\mu$ in breadth, costae 5 in 10$\mu$.

Hab. No. 10. Distr. Interior of Asia, Europe.

**Hantzschia amphioxys** var. **pusilla** DIPPEL in A. CLEVE Diat. Schw. Finn. **5**, p. 48, f. 1419l, 1952.

Valves 35–38$\mu$ in length and 7–7.5$\mu$ in breadth.

Hab. No. 4. Distr. Europe.

**Nitzschia palea** (KÜTZ.) W. SMITH in A. CLEVE Diat. Schw. Finn. **5**, p. 90, f. 1504a, 1952.

Valves 52–56$\mu$ in length and 6–6.5$\mu$ in breadth.

Hab. No. 7. Distr. Central Asia, Afghanistan, Europe.

**Nitzschia ignorata** KRASSKE in HUSTEDT Süssw.-fl. **10**, p. 422, f. 819, 1930. —*Nitzschia filiformis* (W. SMITH) HUSTEDT var. *ignorata* (KRASSKE) A. CLEVE in Diat. Schw. Finn. **5**, p. 78, f. 1478, 1952.

Valves 83–85$\mu$ in length and 7–7.5$\mu$ in breadth.

Hab. No. 4. Distr. Europe.

Heterokontae

Chlorobotrydaceae

**Chlorobotrys limneticus** G. M. SMITH in Wisc. Bull. **57**, p. 82, pl. 15, f. 9, 1920.

Diameter of colony 52$\mu$, cell 8.6$\mu$ in diameter. Cells broadly elliptic.

Hab. No. 4. Distr. U. S. A.

Chlorophyta

Chlamidomonadaceae

**Chlorogonium maximum** SKUJA in Symb. Bot. Ups. **9**: 3, p. 93, pl. 9, f. 21, 1955.

Cells 86–89$\mu$ in length and 13–13.7$\mu$ in breadth.

Hab. No. 2. Distr. Europe.

Volvocaceae

**Eudorina elegans** Ehrenb. in Smith Wisc. Bull. **57**, p. 96, pl. 19, f. 1, 1920; Pascher Süssw.-fl. **4**, p. 440, f. 394-401, 1930.

Colony 52$\mu$ in diameter, cell 8.6$\mu$ in diameter.

Hab. No. 7. Distr. Cosmopolitan.

Palmellaceae

**Sphaerocystis Schröteri** Chodat in Smith Wisc. Bull. **57**, p. 101, pl. 19, f. 3-4, 1920.

Colony about 130$\mu$ in diameter; cells about 13$\mu$ in diameter.

Hab. No. 1. Distr. Cosmopolitan.

Selenastraceae

**Kirchneriella lunaris** (Kirchn.) Möbius in Brunthaler Süssw.-fl. **5**, p. 180, f. 264, 1915; Prescott Alg. Great Lake Area p. 258, pl. 58, f. 2, 1951.

Hab. No. 1, Distr. Europe, U. S. A.

Chlorellaceae

**Tetraedron minimum** (A. Br.) Hansg. in Skuja Nov. Act. Reg. Soc. Sci. Upsal. ser. IV, **16**: 3, p. 175, pl. 26, f. 18, 1956.

Hab. No. 5. Distr. Burma, China, Manchuria, Siberia, Borneo, Europe, Greenland, North America, Brazil, Africa.

Chlorococcaceae

**Characium limneticum** Lemm. in Brunthaler Süssw.-fl. **5**, p. 84, f. 41, 1915; Skuja Symb. Bot. Upsal. IX: 3, p. 125, pl. 15, f. 7-10, 1948.

Cells 103$\mu$ in length and 4.3$\mu$ in breadth.

Hab. No. 5. Distr. Europe, U. S. A.

Oocystaceae

**Chodatella ciliata** (Lagerh.) Lemm. in Skuja Nov. Act. Reg. Soc. Sci. Upsal. ser. IV, **16**: 3, p. 170, pl. 26, f. 10, 1956.—***Lagerheimia ciliata*** (Lagerh.) Chodat in Smith Wisc. Bull. **57**, p. 129, pl. 31, f. 1-2, 1920.

Cells without spine, 17.2$\mu$ in length and 10.8$\mu$ in breadth. (Pl. I, fig. 3, 4.)

Hab. No. 5. Distr. Europe, North America.

Hydrodictyaceae

**Pediastrum boryanum** (TURP.) MENEGH. in SMITH Wisc. Bull. **57**, p. 169, pl. 46, f. 2–7, 1920; SKUJA Symb. Bot. Upsal. IX: 3, p. 127, 1948.

Hab. Rocky pool above the bridge of Chrang. Distr. Cosmopolitan.

Scenedesmaceae

**Micractinium pusillum** FRES. in SMITH Wisc. Bull. **57**, p. 125, pl. 28, f. 1–3, 1920.

Cells 5.6$\mu$ in diameter; length of spine 56$\mu$. (Pl. I, fig. 5.)

Hab. No. 7. Distr. Europe, U. S. A.

**Scenedesmus protuberans** FRITSCH & RICH in Trans. Roy. Soc. S. Afr. **18**, p. 31, f. 6, 1929.

Cell 25.8$\mu$ in length and 7.7$\mu$ in breadth; length of spine 26$\mu$. (Pl. I, fig. 6.)

Hab. No. 5. Distr. S. Africa.

**Scenedesmus falcatus** CHODAT in Ztschr. Hydrol. **3**, p. 146, f. 36, 37, 1926; THOMASSON Act. Phytogeogr. Suec. **32**, p. 56, f. 5: 6, 1953; SKUJA Nov. Act. Reg. Soc. Sci. Upsal. ser. IV, **16**: 3, p. 178, pl. 28, f. 25, 1956.

Cells 25–26$\mu$ in length and 6.4–7$\mu$ in breadth.

Hab. No. 5. Distr. Burma, Japan, Europe.

**Scenedesmus dimorphus** (TURP.) KÜTZ. in SMITH Wisc. Bull. **57**, p. 151, pl. 37, f. 15–17, 1920.

Hab. No. 6. Distr. Europe, U. S. A.

**Scenedesmus Bernardii** G. M. SMITH in Wisc. Bull. **57**, p. 152, pl. 38, f. 5–9, 1920; Trans. Amer. Micr. Soc. **45**, p. 189, pl. 16, f. 16–18, 1926.

Cell 17$\mu$ in length and 3.4$\mu$ in breadth. (Pl. I, fig. 1.)

Hab. No. 7. Distr. Java, U. S. A.

**Scenedesmus quadricauda** (TURP.) BRÉB. in SMITH Wisc. Bull. **57**, p. 158, pl. 40, f. 9–11, 1920.

Hab. No. 7. Distr. Cosmopolitan.

Desmidiaceae

**Closterium venus** KÜTZ. var. **incurvum** (BRÉB.) KRIEGER in Krypt. Fl.

13, p. 273, 1935; Hirano Contr. Biol. Lab. Kyoto Univ. 1, p. 43, pl. 6, f. 4, 1955.

Length 51.6$\mu$, breadth 8.6$\mu$.

Hab. No. 1. Distr. Japan, Siberia, Manchuria, Ceylon, Burma, Europe, N. America, Brazil.

**Closterium setaceum** Ehrenb. in West Monogr. Brit. Desm. 1, p. 122, 1904; Hirano Contr. Biol. Lab. Kyoto Univ. 1, p. 40, pl. 6, f. 1, 7, 1955.

Length 385$\mu$, breadth 17.2$\mu$.

Hab. No. 2. Distr. Cosmopolitan.

**Closterium moniliferum** (Bory) Ehrenb. in West Monogr. Brit. Desm. 1, p. 142, 1904; Hirano Contr. Biol. Lab. Kyoto Univ. 1, p. 46, pl. 3, f. 6, 1955.

Length 236.5$\mu$, breadth 36.6$\mu$.

Hab. No. 1. Distr. Cosmopolitan.

**Closterium parvulum** Näg. in West Monogr. Brit. Desm. 1, p. 133, 1904; Hirano Contr. Biol. Lab. Kyoto Univ. 1, p. 43, pl. 4, f. 13, 1955.

Length 124–125$\mu$, breadth 10.5–11$\mu$.

Hab. No. 1. Distr. Cosmopolitan.

**Pleurotaenium trabecula** (Ehrenb.) Näg. in West Monogr. Brit. Desm. 1, p. 209, 1904; Hirano Contr. Biol. Lab. Kyoto Univ. 2, p. 62, pl. 10, f. 5, 8, 11, 1956.

Length 616$\mu$, breadth 23.7$\mu$.

Hab. No. 2. Distr. Cosmopolitan.

**Pleurotaenium inermium** (Möbius) Hirano in Contr. Biol. Lab. Kyoto Univ. 2, p. 71, pl. 12, f. 5, 1956.—*Pl. ovatum* Nordst. var. ***inermius*** Möb. in Krieger Krypt. Fl. 13, Abt. 1, p. 435, 1937.

Length 385$\mu$, breadth 86$\mu$, Isthmus 60$\mu$. (Pl. I, fig. 14.)

Hab. No. 5. Distr. Japan, Formosa, Australia, Brazil, Uruguay.

**Cosmarium pseudoprotuberans** Kirchn. in West Monogr. Brit. Desm. 3, p. 82, 1908; Hirano Contr. Biol. Lab. Kyoto Univ. 2, p. 105, pl. 22, f. 14, 1956.

Length 32.3$\mu$, breadth 25.8$\mu$, isthmus 6.4$\mu$.

Hab. No. 1. Distr. Japan, India, Europe, Africa, N. America.

**Cosmarium Meneghinii** Bréb. in West Monogr. Brit. Desm. 3, p. 90, 1908; Hirano Contr. Biol. Lab. Kyoto Univ. 4, p. 162, pl. 25, f. 17, 1957.

Length 23$\mu$, breadth 15$\mu$, isthmus 4$\mu$.

Hab. No. 2. Distr. Cosmopolitan.

**Cosmarium Lundellii** Delp. var. **ellipticum** West in Monogr. Brit. Desm. 2, p. 138, 1905; Hirano Contr. Biol. Lab. Kyoto Univ. 4, p. 120, pl. 22, f. 8, 1957.

Length 58$\mu$, breadth 38.7$\mu$, isthmus 13$\mu$.

Hab. No. 4. Distr. Japan, Formosa, Manchuria, Europe, Canada.

**Cosmarium obtusatum** Schmidle in West Monogr. Brit. Desm. 3, p. 7, 1908.

Length 64–66$\mu$, breadth 52$\mu$, isthmus 17$\mu$.

Hab. No. 1. Distr. Japan, Siberia, China, Europe, Africa, N. America.

**Cosmarium impressulum** Elfv. in West Monogr. Brit. Desm. 3, p. 86, 1908; Hirano Contr. Biol. Lab. Kyoto Univ. 4, p. 163, pl. 25, f. 24–26, 1957.

Length 25.8$\mu$, breadth 19.4$\mu$, isthmus 6.4$\mu$.

Hab. No. 1. Distr. Japan, China, Manchuria, Siberia, Europe, N. America.

**Cosmarium moniliforme** (Turp.) Ralfs in West Monogr. Brit. Dism. 3, p. 20, 1908; Hirano Contr. Biol. Lab. Kyoto Univ. 2, p. 89, pl. 17, f. 6, 1957.

Length 39.6$\mu$, breadth 23.7$\mu$, isthmus 10.8$\mu$.

Hab. No. 1. Distr. Cosmopolitan.

**Cosmarium granatum** Bréb. in West Monogr. Brit. Desm. 2, p. 186, 1905; Hirano Contr. Biol. Lab. Kyoto Univ. 4, p. 129, pl. 22, f. 23, 1957.

Length 28$\mu$, breadth 18.5$\mu$, isthmus 5.2$\mu$.

Hab. No. 1. Distr. Cosmopolitan.

**Cosmarium abbreviatum** Racib. forma **pygmaea** Messik. in Viertelj. Naturf. Ges. Zurich **80**, p. 44, pl. 4, f. 47–49, 1935; Hirano Contr. Biol. Lab. Kyoto Univ. 4, p. 159, pl. 25, f. 48, 49, 1957.

Length 13.3$\mu$, breadth 14.2$\mu$, isthmus 6$\mu$.

Hab. Glacier lake below Rarkya Pass. Distr. Japan, Switzerland.

**Cosmarium undulatum** Corda var. **crenulatum** (Näg.) Wittr. in West Monogr. Brit. Desm. 2, p. 150, 1905.

Length 30$\mu$, breadth 23.7$\mu$, isthmus 6.2$\mu$.

Hab. No. 1. Distr. Japan, India, Europe, Spitzbergen, Brazil.

**Cosmarium undulatum** var. **minutum** WITTR. in CROASDALE Trans. Amer. Micr. Soc. **75**, p. 59, pl. 3, f. 11, 1956; HIRANO Contr. Biol. Lab. Kyoto Univ. **4**, p. 117, pl. 19, f. 13, 1957.

Length 26.7$\mu$, breadth 23.7$\mu$, isthmus 10.8$\mu$.

Hab. Glacier lake below Rarkya Pass. Distr. Japan, Manchuria, Europe, N. America.

**Cosmarium bipunctatum** BÖRG. in WEST Monogr. Brit. Desm. **3**, p. 213, pl. 85, f. 6, 1908; HIRANO Contr. Biol. Lab. Kyoto Univ. **5**, p. 184, pl. 28, f. 11, 1957.

Length 19.4$\mu$, breadth 17.2$\mu$, isthmus 6.3$\mu$.

Hab. No. 1. Distr. Japan, Europe, N. America, Brazil.

**Comarium quadrum** LUND. var. **minus** NORDST. in WEST Monogr. Brit. Desm. **4**, p. 21, 1911; HIRANO Contr. Biol. Lab. Kyoto Univ. **5**, p. 202, pl. 29, f. 2, 1957.

Length 53.8$\mu$, breadth 51.6$\mu$, isthmus 19.4$\mu$.

Hab. No. 1. Distr. Japan, Manchuria, Europe, Greenland, U. S. A.

**Cosmarium dichondrum** W. & G. S. WEST in HIRANO Cont. Biol. Lab. Kyoto Univ. **5**, p. 187, pl. 27, f. 21, 1957.

Length 31.4$\mu$, breadth 28$\mu$, isthmus 8.6$\mu$. (Pl. III, fig. 16.)

Hab. No. 1. Distr. Japan, Burma.

**Micrasterias radians** TURNER in KRIEGER Krypt. Fl. **13**, Abt. 2, p. 67, pl. 115, f. 8, pl. 116, f. 1, 1939.

Length 172–180$\mu$, breadth 155–160$\mu$, isthmus 21.5–26$\mu$.

Hab. No. 1. Distr. India, Japan.

**Staurastrum Manfeldtii** DELP. in WEST & CARTER Monogr. Brit. Desm. **5**, p. 114, pl. 148, f. 2, 1923; MESSIKOMMER Hedw. **78**, p. 187, pl. 10, f. 111, 1938.

Length 49$\mu$, breadth without proc. 30$\mu$, with proc. 79.5$\mu$, isthmus 13$\mu$. There are distinct verrucae on the basal part of the Nepalese forms and also imperfect ones at the inferior base of the processes which are produced horizontally. The cells in vertical view have a pair of emarginate verrucae within

each lateral margin and these verrucae are continued to the serie of denticulations along the inner side of the processes. The processes are somewhat slender and resemble the var. *annulatum*, but differ from it by the lack of double series of granules. (Pl. III, fig. 14.)

Hab. No. 1. Distr. India, China, Europe.

**Staurastrum orbiculare** RALFS var. **depressum** ROY & BISSET in Journ. Bot. **24**, p. 237, 1886; WEST Monogr. Brit. Desm. **4**, p. 158, 1911; HIRANO Contr. Biol. Lab. Kyoto Univ. **7**, p. 290, pl. 37, f. 18, 1959.

Hab. No. 1. Distr. China, Thailand, Sumatra, Japan, Manchuria, Siberia, U. S. A., Australia, New Zealand.

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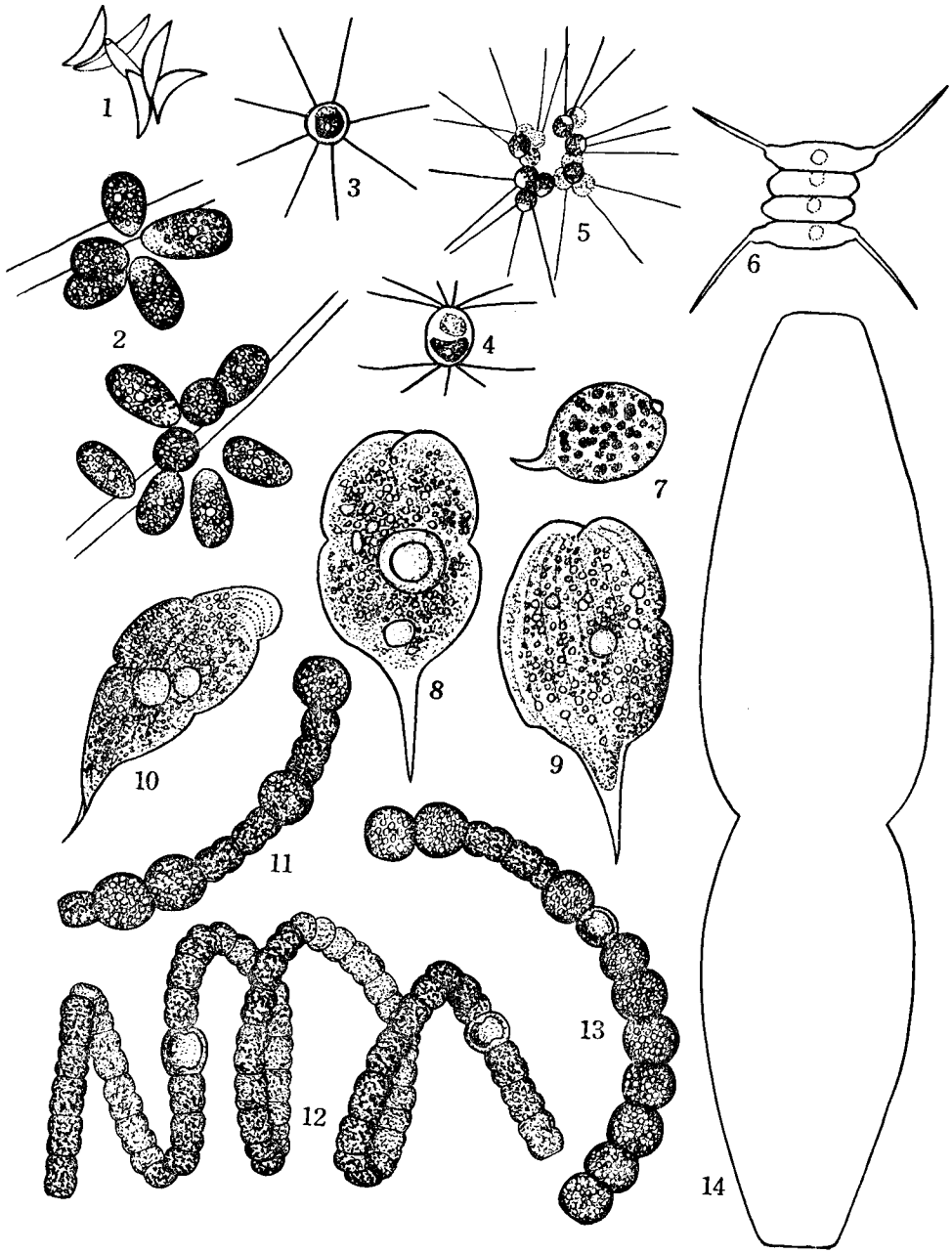
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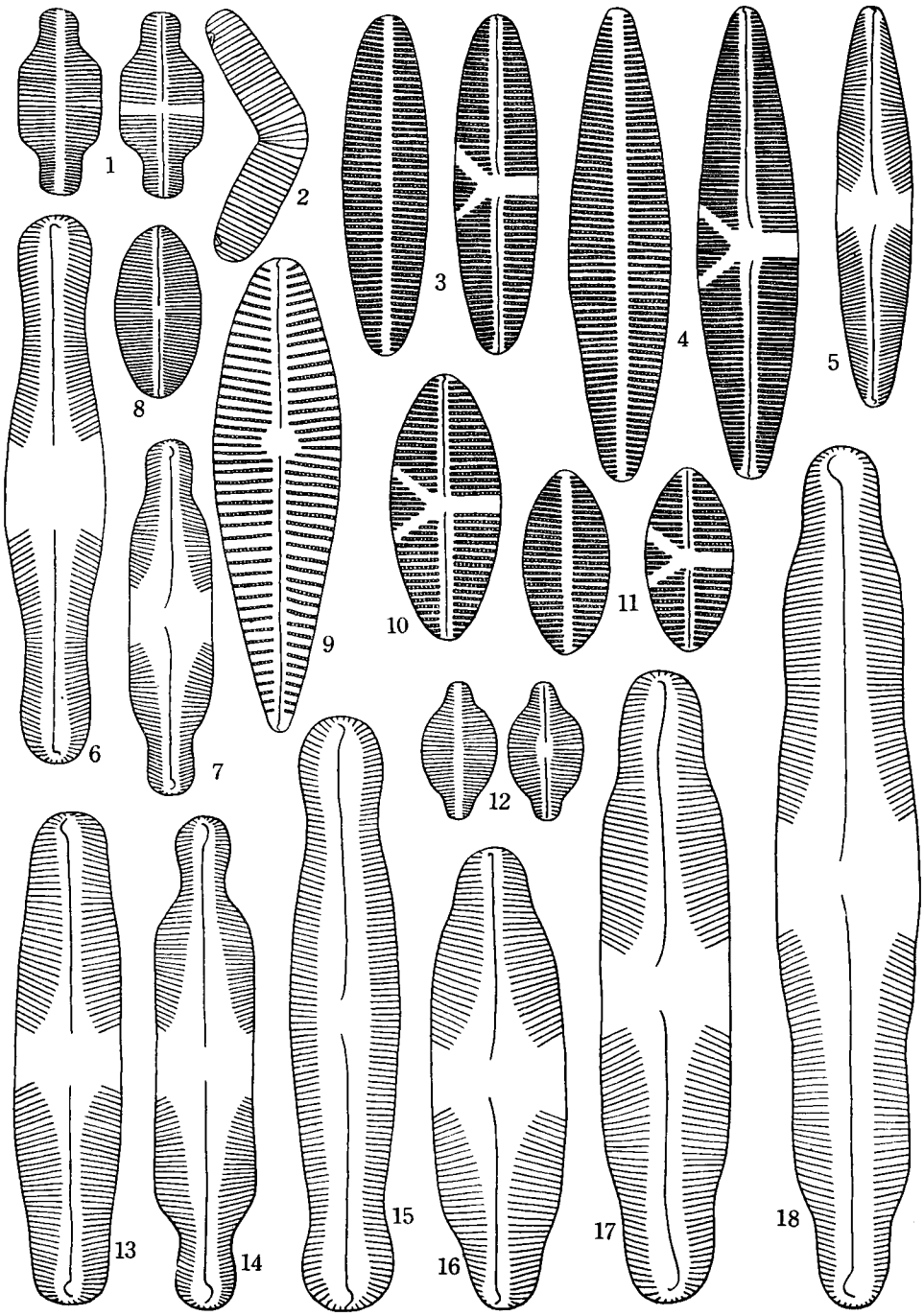
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2. G. turris (EHRENB.) GRUN. var. nepalense HIRANO ..... 16
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10. N. peregrina (EHRENB.) KÜTZ. var. hankensis SKVORTZOW..... 11
11. N. dicephala (EHRENB.) W. SMITH ..... 11
12. Gomphonema olivaceum (LYNGB.) KÜTZ. var. subramosum GRUN... 16
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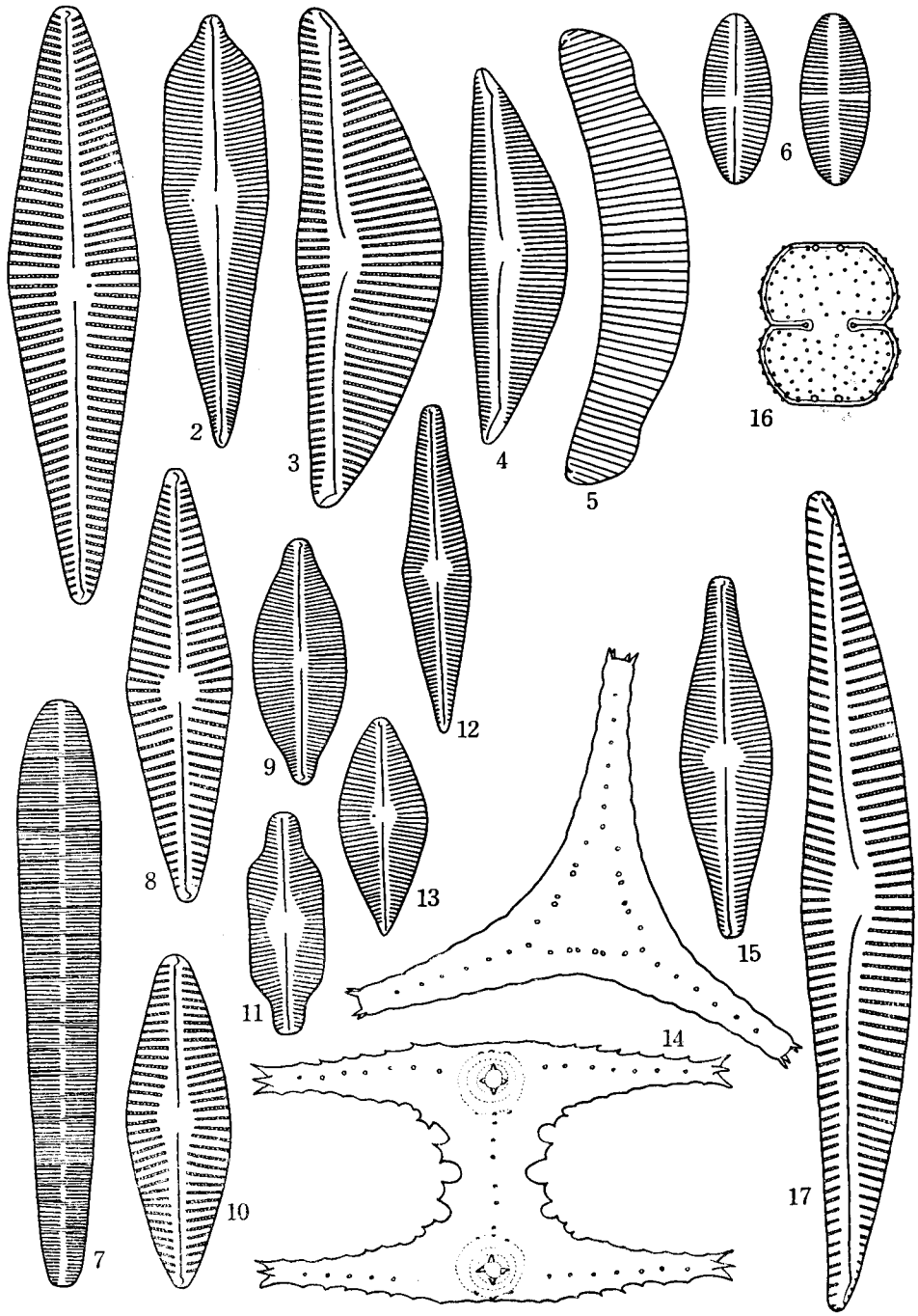
15. Navicula cryptocephala KÜTZ ..... 10
16. Cosmarium dichondrum W. & G. S. WEST ..... 22
17. Cymbella helvetica KÜTZ. ..... 15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